result in overturning of the wheelchair, particularly when descending a slope. The problem is exacerbated by the fact that such wheelchairs have a relatively short wheelbase and a relatively high centre of gravity. In some situations the height of the centre of gravity is increased by heavy batteries, which are used to power the wheelchair, being mounted in the chassis beneath the seat.

The problem is exacerbated with a wheelchair incorporating a suspension assembly which permits the load to tilt forward, thereby enabling the centre of gravity to move marginally forward also.

Problems in reverse arise with non-powered push-chairs and wheelchairs with suspension when the chair is tilted backwards to effect steering or to mount a large obstacle. Downwards pressure on the pushing handle must take up suspension movement before the front wheels lift off the ground. This is less precise than for a rigid chair.

It is an object of the present invention to overcome or minimise these problems.

According to the present invention there is provided a wheeled conveyance comprising a chassis, support means for a load mounted on the chassis, a suspension assembly mounted on the chassis and comprising spring means and suspension arms pivotably mounted on the chassis and extending in forward and rearward directions in the region of opposite sides of the chassis, each suspension arm having a (ground-engaging) wheel rotatably mounted at the free end thereof, and at least one shock absorber means acting on at least part of the suspension assembly

and adapted and arranged to limit tilting of the chassis relative to at least part of the suspension assembly under dynamic load conditions tending to produce such tilting.

The wheels mounted at the free ends of one of the forwardly extending and rearwardly extending suspension arms may be arranged to swivel, for example about a generally upright axis, such as independently of one another.

The wheels arranged to swivel may be adapted to swivel through a predetermined limited range.

The wheeled conveyance may be self-propelled or may be non-powered.

The self-propelled wheeled conveyance may comprise a motorised wheelchair, having a support means comprising a seat, and a load comprising a person to be transported.

Where the wheeled conveyance is self-propelled, the wheels mounted at the free ends of the suspension arms extending in the rearward direction may each be motor-driven and the wheels mounted at the free ends of the suspension arms extending in the forward direction may be arranged to swivel.

Alternatively, the wheels mounted at the free ends of the suspension arms extending in the forward direction may each be motor-driven and the wheels mounted at the free ends of the suspension arms extending in the rearward direction may be arranged to swivel.

The motor-driven wheels may be powered by separate motors, which may be electric motors, which may be powered by one or more batteries which may be mounted on the chassis.

A manually-operated controller, such as a joystick, may be provided for controlling the motors whereby motion and steering of the conveyance is controlled.

Two separate spring means may be provided, one disposed in the region of each side of the chassis and acting between the forwardly and rearwardly extending suspension arms in such a way that the free ends thereof tend to pivot towards each other.

The at least one shock absorber means may be adjustable to effect a desired extent of limitation of the tilting of the chassis.

The at least one shock absorber means may be adapted and arranged whereby tilting of the chassis is substantially minimised.

The at least one shock absorber means may be arranged whereby upward and downward movement of the wheels on the suspension arms is substantially uninhibited thereby in the absence of tilting motion of the chassis.

The at least one shock absorber means may be provided cooperating between the chassis and the suspension arms extending in the forward direction to limit forward tilting of the chassis relative to at least part of the suspension assembly.

Two shock absorber means may be provided, separately cooperating between the chassis and each of the suspension arms extending in the forward direction. Each of the shock absorber means may be of elongate telescopic form, having one end thereof pivotably secured to the chassis and an opposite end thereof pivotably secured to the associated forwardly extending suspension arm or to a strut extending upwardly from the associated forwardly extending suspension arm. Each of the shock absorber means of elongate telescopic form may undergo pivoting during corresponding pivoting of its associated forwardly extending suspension arm.

The two shock absorber means may be disposed in a substantially horizontal plane.

The two shock absorber means may operate simultaneously and collectively to limit the forward tilting of the chassis, with each shock absorber means acting independently on its associated forwardly extending suspension arm.

Alternatively, the at least one shock absorber means may be provided cooperating between the suspension arms extending in the forward direction and the suspension arms extending in the rearward direction to limit tilting of the chassis relative to at least part of the suspension assembly.

Two shock absorber means may be provided, separately cooperating between the forwardly and rearwardly extending suspension arms. Each of the shock absorber means may be of elongate telescopic form, having one end thereof pivotably secured to the associated forwardly extending suspension arm and an opposite end thereof

pivotably secured to the associated rearwardly extending suspension arm. Each of the shock absorber means of elongate telescopic form may undergo pivoting during corresponding pivoting of the suspension arms.

The two shock absorber means may be disposed in a substantially upright plane.

The two shock absorber means may operate simultaneously and collectively to limit the tilting of the chassis, with each shock absorber means acting independently on its associated suspension arms.

For a better understanding of the present invention and to show more clearly how it may be carried into effect, reference will now be made, by way of example, to the accompanying drawings in which:

Figure 1 is a side view of an embodiment of a self-propelled wheeled conveyance according to the present invention, in the form of a motorised wheelchair;

Figure 2 is a top plan view of the self-propelled wheeled conveyance of Figure 1;

Figure 3 is an end view of a chassis for use in the self-propelled wheeled conveyance of Figures 1 and 2;

Figure 4 is a side view of another embodiment of a self-propelled wheeled conveyance according to the present invention, in the form of a motorised wheelchair;

Figure 5 is a top plan view of the self-propelled wheeled conveyance of Figure 4;

Figure 6 is a side view of an embodiment of a chassis forming part of a non-powered wheeled conveyance according to the present invention;

Figure 7 is a top plan view of the wheeled conveyance chassis of Figure 6; and

Figure 8 is an end view of the wheeled conveyance chassis of Figures 6 and 7.

Referring to Figures 1, 2 and 3, a motorised wheelchair 2 has a tubular metal chassis 4, which is shown in detail in Figure 3, on which is secured a seat 6 for supporting a person to be transported in the wheelchair.

A suspension assembly is mounted on the chassis 4 and comprises two suspension arms 8 pivotably mounted at ends 10 thereof on lower portions 12 of T-shaped brackets 14 provided at opposite sides of the chassis 4. The suspension arms 8 extend in a forward direction and have ground-engaging wheels 16, rotatably mounted and arranged to swivel about a generally upright axis, at free ends 18 thereof.

Two further suspension arms 20 are pivotably mounted at ends 22 thereof on upper portions 24 of the T-shaped brackets 14 at opposite sides of the chassis 4. The suspension arms 20 extend in a rearward direction and have ground-engaging wheels 26 rotatably mounted at free ends 28 thereof. Each wheel 26 is independently driven by a separate electric motor 30 mounted on each of the suspension arms 20.

The electric motors 30 are energised by one or more batteries (not shown) mounted on the chassis 4, such as

below the seat 6. Power to the motors 30 is independently controlled through a joystick controller (not shown) of well-known form and by means of which steering and motion control of the wheelchair are effected.

Two springs 32 are provided, only one of which is shown in the drawings.

The springs 32 are disposed in the region of each side of the chassis 4 and act between the forwardly and rearwardly extending suspension arms 8 and 20 in such a way that the free ends 18 and 28 of the suspension arms 8 and 20 tend to pivot towards each other.

The suspension arms 8, 20 and the springs 32 may incorporate features as described and claimed in EP-A-0 836 979.

The wheelchair 2 is arranged to move forward in the direction of arrow 34, the swivelling wheels 16 being at the front.

If the joystick controller (not shown) is released while the wheelchair 2 is in motion, a dead man's handle arrangement incorporated in the controller shuts off the power to the motors 30 and the wheelchair is braked and comes to an immediate halt. When this happens, the chassis 4 will tend to tilt forward as shown by the arrow 36. This is undesirable and in severe conditions, particularly when the wheelchair 2 is located on downward-sloping ground, could result in overturning of the wheelchair 2. Such tendency for the chassis 4 to tilt forward may also occur when the wheelchair descends

a gradient, or drops over a kerb or into a pothole, and is reduced or minimised in the present invention.

A shock absorber 38 is provided at each side of the chassis 4. The shock absorbers 38 are suitably of elongate telescopic form and each has one end 40 thereof pivotably secured to a mounting 42 on the chassis 4 and an opposite end 44 pivotably secured to a strut 46 extending upwardly from an associated forwardly extending suspension arm 8. The shock absorbers 38 are disposed in a substantially horizontal plane.

The two shock absorbers 38 act simultaneously to damp any forward tilting movement of the chassis 4, such as when power to the motors 30 is interrupted and the wheelchair 2 comes to an abrupt halt. The shock absorbers 38 are preferably adjustable whereby their damping action can be tuned such that forward tilting movement of the chassis 4 is minimised.

Although the two shock absorbers 38 operate simultaneously and collectively to limit the forward tilting movement of the chassis 4, each shock absorber 38 acts independently on its associated suspension arm 8 as when the suspension travels along an irregular surface.

The shock absorbers 38 undergo pivoting about their ends 40, 44 during corresponding pivoting of their associated forwardly extending suspension arms 8. Upward and downward movement of the wheels 16 on the suspension arms 8 is substantially uninhibited by the shock absorbers 38 in the absence of forward tilting motion of the chassis 4.

The shock absorbers 38 are arranged such that articulation of the suspension system is retained. Such articulation is important to ensure that the driving wheels 26 maintain contact with ground surface. If a driving wheel 26 were to undesirably leave the ground, the wheelchair 2 would veer away from its intended direction of travel.

Figures 4 and 5 show an alternative embodiment of a motorised wheelchair according to the present invention. The motorised wheelchair 2 in Figures 4 and 5 differs from that of Figures 1, 2 and 3 in that the motor-driven wheels 26 are provided at the front of the wheelchair and the swivelling wheels 16 are provided at the rear of the wheelchair.

In Figures 4 and 5, parts fulfilling the same or similar functions as those in Figures 1, 2 and 3 are given the same reference numerals as those in Figures 1, 2 and 3.

Accordingly, the motorised wheelchair 2 shown in Figures 4 and 5 has a tubular metal chassis 4, constructed as shown in Figure 3, and on which is secured a seat 6 for supporting a person to be transported in the wheelchair.

A suspension assembly is mounted on the chassis 4 and comprises two suspension arms 8 pivotably mounted at ends 10 thereof at opposite sides of the chassis 4. The suspension arms 8 extend in a forward direction and have wheels 26 rotatably mounted at free ends 18 thereof. Each wheel 26 is independently driven by a separate electric motor 30 mounted on each of the suspension arms 8.

The shock absorbers 38 act in exactly the same way as those previously described with reference to Figures 1 and 2, to minimise forward tilting movement of the chassis 4 in the direction of arrow 36, such as when power to the motors 30 is interrupted and the wheelchair 2 comes to an abrupt halt, or when the wheelchair 2 descends a gradient, or drops over a kerb or into a pothole.

Figures 6, 7 and 8 show an embodiment of a chassis of a non-powered push-chair or wheelchair according to the present invention. The push-chair or wheelchair chassis 2 in Figures 6 to 8 differs from that of Figures 1 to 3 in that the wheels are not swivelable and the shock absorber 38 is mounted in an upright configuration.

In Figures 6, 7 and 8, parts fulfilling the same or similar functions as those in Figures 1, 2 and 3 are given the same reference numerals as those in Figures 1, 2 and 3.

Accordingly, the wheeled conveyance shown in Figures 6 to 8 has a tubular metal chassis 4 adapted to receive a seat (not shown) for supporting an infant or person to be transported. A seat or other support means can readily be mounted on the chassis 4 in a manner similar to that shown in Figures 1, 3 and 4.

A suspension assembly is mounted on the chassis 4 and comprises two suspension arms 8 pivotably mounted at ends 10 thereof at opposite sides of the chassis 4. The suspension arms 8 extend in a forward direction and have wheels 16 rotatably mounted at free ends 18 thereof.

CLAIMS

1. A wheeled conveyance (2) characterised by comprising a chassis (4), support means for a load mounted on the chassis (4), a suspension assembly mounted on the chassis (4) and comprising spring means (32) and suspension arms (8, 20) pivotably mounted on the chassis (4) and extending in forward and rearward directions in the region of opposite sides of the chassis (4), each suspension arm having a wheel (16, 26) rotatably mounted at the free end (18, 28) thereof, and at least one shock absorber means (38) acting on at least part of the suspension assembly and adapted and arranged to limit tilting of the chassis (4) relative to at least part of the suspension assembly under dynamic load conditions tending to produce such tilting.

2. A wheeled conveyance as claimed in claim 1, characterised in that the wheels (16, 26) mounted at the free ends (18, 28) of one of the forwardly extending and rearwardly extending suspension arms (8, 20) are arranged to swivel independently of one another

3. A wheeled conveyance as claimed in claim 1 or 2, characterised in that the wheels (16, 26) mounted at the free ends (18, 28) of one of the forwardly extending and rearwardly extending suspension arms (8, 20) are arranged to swivel about a generally upright axis.

4. A wheeled conveyance as claimed in claim 2 or 3, characterised in that the wheels (16, 26) arranged to swivel are adapted to swivel through a predetermined limited range.

5. A wheeled conveyance as claimed in any preceding claim, characterised in that the wheeled conveyance is non-powered.

6. A wheeled conveyance as claimed in any one of claims 1 to 4, characterised in that the wheeled conveyance is self-propelled.

7. A wheeled conveyance as claimed in claim 6, characterised in that the self-propelled wheeled conveyance comprises a motorised wheelchair, having a support means comprising a seat (6), and a load comprising a person to be transported.

8. A wheeled conveyance as claimed in claim 6 or 7, characterised in that the wheels (16) mounted at the free ends (28) of the suspension arms (20) extending in the rearward direction are each motor-driven and the wheels (26) mounted at the free ends (18) of the suspension arms (8) extending in the forward direction are arranged to swivel.

9. A wheeled conveyance as claimed in claim 6 or 7, characterised in that the wheels (26) mounted at the free ends (18) of the suspension arms (8) extending in the forward direction are each motor-driven and the wheels (16) mounted at the free ends (28) of the suspension arms (20) extending in the rearward direction are arranged to swivel.

10. A wheeled conveyance as claimed in claim 8 or 9, characterised in that the motor-driven wheels are powered by separate motors (30).

11. A wheeled conveyance as claimed in claim 10, characterised in that the separate motors are electric motors (30).

12. A wheeled conveyance as claimed in claim 11, characterised in that the electric motors (30) are powered by one or more batteries.

13. A wheeled conveyance as claimed in claim 12, characterised in that the one or more batteries are mounted on the chassis (4).

14. A wheeled conveyance as claimed in any one of claims 8 to 13, characterised in that a manually-operated controller is provided for controlling the motors (30) whereby motion and steering of the conveyance is controlled.

15. A wheeled conveyance as claimed in claim 14, characterised in that the manually-operated controller is a joystick.

16. A wheeled conveyance as claimed in any preceding claim, characterised in that two separate spring means (32) are provided, one disposed in the region of each side of the chassis (4) and acting between the forwardly and rearwardly extending suspension arms (8, 20) in such a way that the free ends (18, 28) thereof tend to pivot towards each other.

17. A wheeled conveyance as claimed in any preceding claim, characterised in that the at least one shock absorber means (38) is adjustable to effect a desired extent of limitation of the tilting of the chassis (4).

18. A wheeled conveyance as claimed in any preceding claim, characterised in that the at least one shock absorber means (38) is adapted and arranged whereby tilting of the chassis (4) is substantially minimised.

19. A wheeled conveyance as claimed in any preceding claim, characterised in that the at least one shock absorber means (38) is arranged whereby upward and downward movement of the wheels on the suspension arms is substantially uninhibited thereby in the absence of tilting motion of the chassis (4).

20. A wheeled conveyance as claimed in any preceding claim, characterised in that the at least one shock absorber means (38) is provided cooperating between the chassis (4) and the suspension arms (8) extending in the forward direction to limit forward tilting of the chassis (4) relative to at least part of the suspension assembly.

21. A wheeled conveyance as claimed in claim 20, characterised in that two shock absorber means (38) are provided, separately cooperating between the chassis (4) and each of the suspension arms (8) extending in the forward direction.

22. A wheeled conveyance as claimed in claim 21, characterised in that each of the two shock absorber means (38) are of elongate telescopic form, having one end (40) thereof pivotably secured to the chassis (4) and an opposite end (44) thereof pivotably secured to the associated forwardly extending suspension arm (8).

23. A wheeled conveyance as claimed in claim 21, characterised in that each of the two shock absorber means (38) are of elongate telescopic form, having one

end (40) thereof pivotably secured to the chassis (4) and an opposite end (44) thereof pivotably secured to a strut (46) extending upwardly from the associated forwardly extending suspension arm (8).

24. A wheeled conveyance as claimed in claim 22 or 23, characterised in that each of the shock absorber means of elongate telescopic form undergo pivoting during corresponding pivoting of its associated forwardly extending suspension arm (8).

25. A wheeled conveyance as claimed in any one of claims 21 to 24, characterised in that the two shock absorber means (38) are disposed in a substantially horizontal plane.

26. A wheeled conveyance as claimed in any one of claims 21 to 25, characterised in that the two shock absorber means (38) operate simultaneously and collectively to limit the forward tilting of the chassis (4), with each shock absorber means acting independently on its associated forwardly extending suspension arm (8).

27. A wheeled conveyance as claimed in any one of claims 1 to 19, characterised in that the at least one shock absorber means (38) is provided cooperating between the suspension arms (8) extending in the forward direction and the suspension arms (20) extending in the rearward direction to limit tilting of the chassis (4) relative to at least part of the suspension assembly.

28. A wheeled conveyance as claimed in claim 27, characterised in that two shock absorber means (38) are provided, separately cooperating between the forwardly and rearwardly extending suspension arms (8, 20).

29. A wheeled conveyance as claimed in claim 28, characterised in that each of the two shock absorber means (38) are of elongate telescopic form, having one end thereof pivotably secured to the associated forwardly extending suspension arm (8) and an opposite end thereof pivotably secured to the associated rearwardly extending suspension arm (20).

30. A wheeled conveyance as claimed in claim 29, characterised in that each of the shock absorber means of elongate telescopic form undergoes pivoting during corresponding pivoting of the forwardly and rearwardly extending suspension arms.

31. A wheeled conveyance as claimed in any one of claims 28 to 30, characterised in that the two shock absorber means (38) are disposed in a substantially upright plane.

32. A wheeled conveyance as claimed in any one of claims 28 to 31, characterised in that the two shock absorber means (38) operate simultaneously and collectively to limit the tilting of the chassis (4), with each shock absorber means (38) acting independently on its associated suspension arms.